Madrean Archipelago Rapid Ecoregional Assessment




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Rapid Ecoregional Assessments

Working with agency partners, BLM is conducting rapid ecoregional assessments (REAs) covering much of the American West. The goal of REAs is to characterize 1) the status of ecological resources, 2) their potential to change at a landscape scale in response to increasing development, changing climate, the spread of invasives, and altered fire regimes, and 3) potential priority areas for conservation, restoration, and development. REAs are a first step in BLM's Landscape Approach, which considers larger geographic areas to more fully recognize natural resource conditions, processes, and trends, natural and human influences, and opportunities for resource conservation, restoration, and development. The landscape approach seeks to identify important ecological values and patterns of environmental change that may not be evident when managing smaller, local land areas.

A landscape approach informs and enhances local management. The BLM field offices maintain their central role in management of public lands. They continue to prepare land-use plans, authorize land uses, conduct monitoring, and work with partners and stakeholders to develop and implement local strategies. The broader perspective provided through a landscape approach will help focus and integrate these local management efforts. A landscape approach also provides an important foundation for developing coordinated management strategies with partner agencies, stakeholders, and American Indian Tribes.

REAs are grounded in ***management questions (MQs)*** that specify the key information needs managers have identified around natural resources management. REAs describe and map ***conservation elements (CEs)***, which are generally features of high ecological value or sensitivity. REAs look across *all* lands in an ecoregion, regardless of ownership, to identify regionally important habitats for fish, wildlife, species of concern, and other features of management interest. REAs then evaluate the potential impacts on CEs from four broad categories of environmental ***change agents (CAs):*** climate change, wildfire, invasive species, and development (such as land use, energy development, infrastructure, or hydrologic alterations).

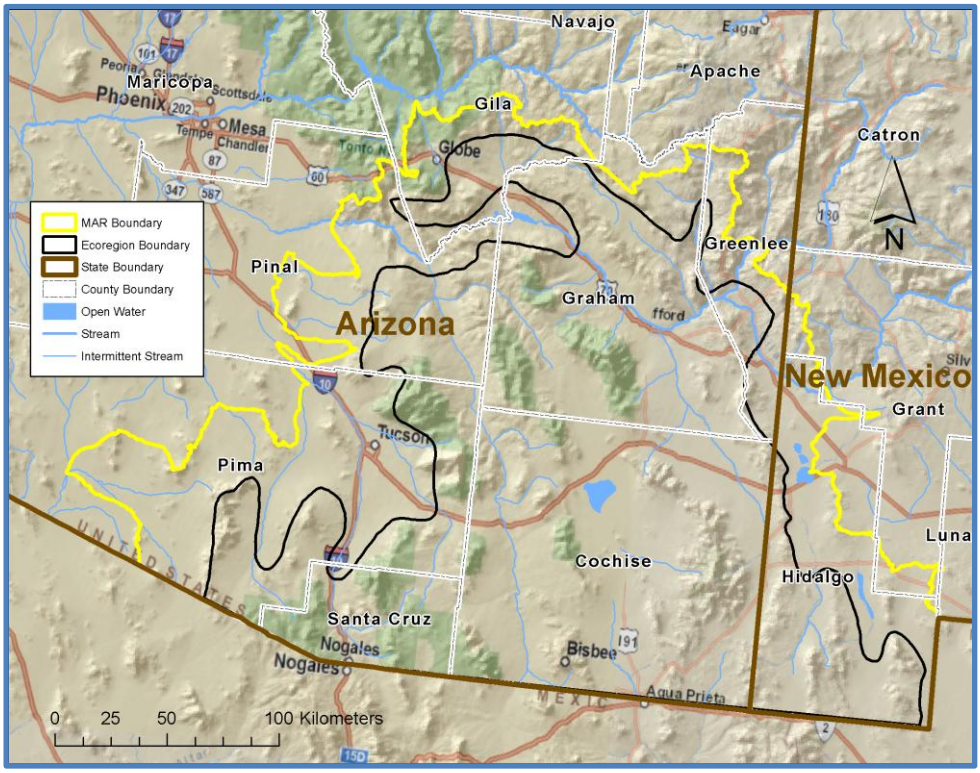
REAs

- **Document key resource values (conservation elements), such as species of concern and regionally significant terrestrial and aquatic habitats**
- **Describe influences and projected effects from four categories of environmental change agents:**
  - **Climate Change**
  - **Wildfire**
  - **Invasive Species**
  - **Development**
- **Identify and characterize important natural resource issues and provide a baseline to guide future management actions**
- **Provide tools and data useful for identifying areas suitable for resource conservation and restoration, as well as development**
- **Identify science gaps and data needs**

For more information: http://www.blm.gov/wo/st/en/prog/more/Landscape_Approach/reas.html

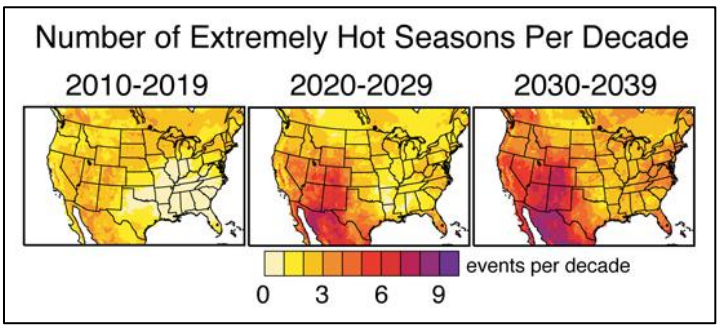
Madrean Archipelago Ecoregion

Spanning the U.S.-Mexico border, the 18.5 million-acre Madrean Archipelago ecoregion is located in southeastern Arizona, southwestern New Mexico, and north central Mexico. The map below shows the U.S. portion in black outline. The yellow boundary in the map outlines the 15.7 million-acre area assessed in this REA. The ecoregion is characterized by isolated, forested mountain ranges surrounded by a virtual sea of intervening deserts and grasslands; thus, the mountains in this area are known as "Sky Islands." The basin and range topography, diversity of soils, and arid, monsoonal climate, are the physical drivers shaping its biological diversity, while hydrology and fire are among the major natural ecosystem processes influencing the biota of this ecoregion. The ecoregion is located within the Madrean Pine – Oak Woodlands, a globally significant biodiversity hot spot, and harbors the highest diversity of mammals, birds, bees, and ants in the contiguous United States. Large elevation gradients and topographic roughness contribute to high diversity of species and biotic communities. The ecoregion is at the intersection of the temperate zone to the north and sub-tropics to the south where several major desert and forest biotic influences converge, including the Rocky Mountains, Sierra Madre, the piedmont and plains of the western Sierra Madre, Sonoran Desert, and Chihuahuan Desert.



Key issues Facing Natural Resource Managers

- Effects of climate change
- Invasive species
- Water availability and hydrology
- Altered fire regime
- Border area infrastructure
- Grazing

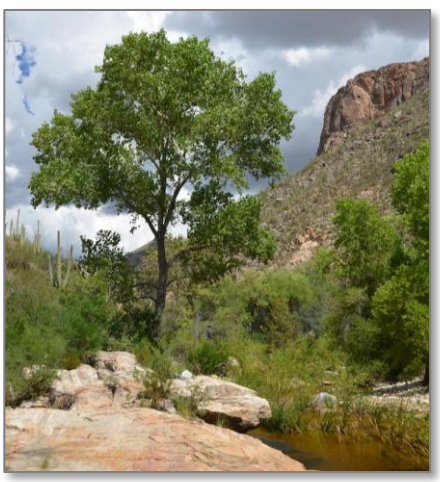


Conservation Elements

Nineteen conservation elements (CEs) were selected for assessment in this REA; 10 ecosystems, 8 species, and the non-natural mesquite upland scrub ecosystem. A detailed conceptual model was developed for each; the conceptual models include descriptive text and diagrams characterizing the CE and its life history or ecosystem dynamics, as well as key ecological attributes and indicators that may be used to assess its ecological status.

Ecological System Name	% of Ecoreg
Valley Dryland Ecological Systems	56.0%
Chihuahuan Creosotebush Desert Scrub	13.2%
Apacherian-Chihuahuan Mesquite Upland Scrub	19.5%
Apacherian-Chihuahuan Semi-Desert Grassland & Steppe	18.2%
Madrean Encinal	5.1%
Connected Stream and Wetland Ecological Systems	4.3%
North American Warm Desert Riparian Woodland & Shrubland, Mesquite Bosque & Stream	3.3%
North American Arid West Emergent Marsh/Cienega & Pond	1.0%
North American Warm Desert Lower Montane Riparian Woodland & Shrubland & Stream	<1%
Montane Dryland Ecological Systems	13.4%
Madrean Pinyon-Juniper Woodland	5.8%
Montane Conifer-Oak Forest & Woodland	2.8%
Mogollon Chaparral	4.8%
Isolated Wetland Ecological Systems	<1%
North American Warm Desert Playa & Ephemeral Lake	<1%

Category	Species Name
Mammal	Desert bighorn sheep
Mammal	Pronghorn
Mammal	Coues deer
Mammal	Black-tailed prairie dog
Mammal	Nectar-feeding bat assemblage
Bird	Grassland bird assemblage
Reptile	Ornate box turtle
Amphibian	Chiricahua leopard frog



Assessments

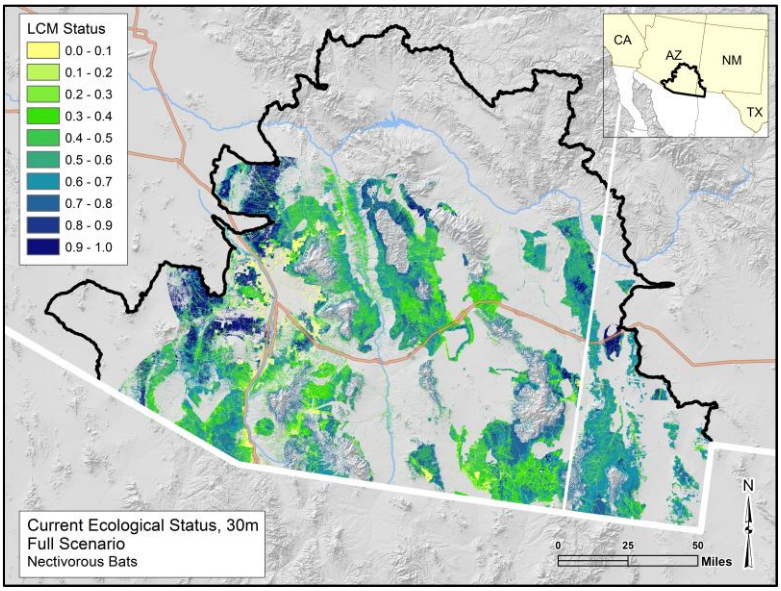
The following pages illustrate examples of the many assessments conducted for the MAR REA including:

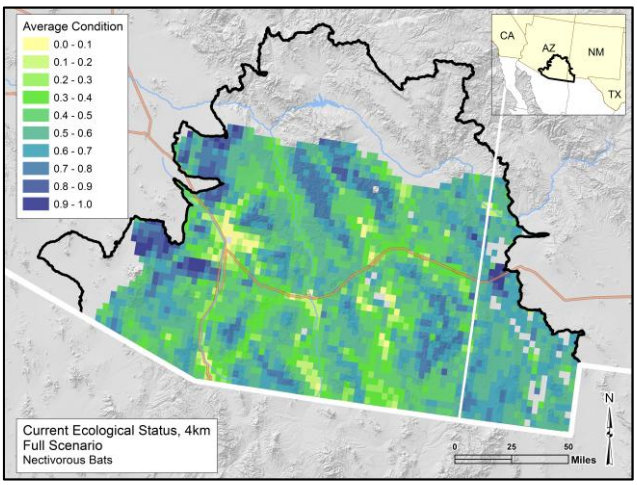
- Current ecological status of conservation elements
- Current ecological integrity of the ecoregion as a whole
- 2025 Risk assessment of three case study CEs
- Climate change trends
- Climate stress exposure for CEs
- Bioclimate envelope models for four CEs
- Areas of moderate to high restoration potential in mesquite-invaded areas
- Areas of soil erosion risk

Products and Key Findings

Conservation Element Ecological Status

Each conservation element was assessed for current status or condition of its mapped distribution. This entailed developing indicators based on the CE's conceptual model, characterizing "scenarios" of mapped change agents associated with these indicators, developing a model of how the CE is expected to respond in the presence of the change agents, and applying the response model to a GIS intersection of the CEs with the CAs to derive numeric scores for each 30 meter pixel of the CE distribution. The pixel results were then averaged to produce a status score per "reporting unit" (4x4 km grids for terrestrial CEs and 5th level watersheds for aquatic CEs).

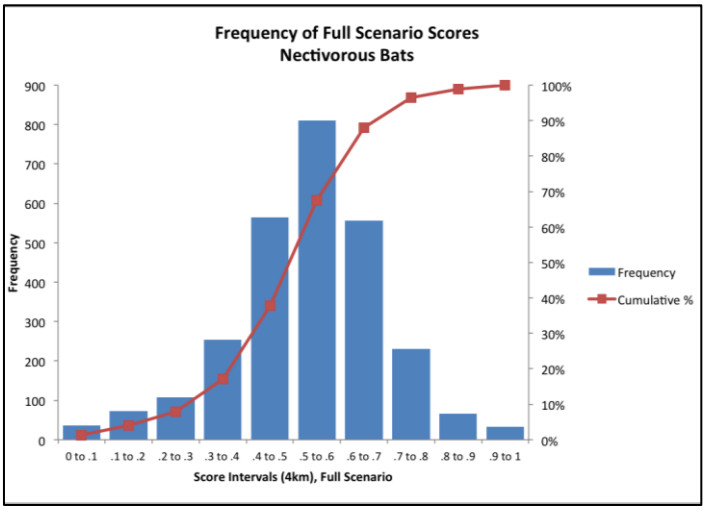




Current overall ecological status scores for the nectivorous bat assemblage

Scores were calculated for each 30m pixel (top) and 4km grid cells (bottom). LCM = landscape condition model. Yellow scores (equivalent to 0) indicate high impacts from the CAs and correspondingly lower ecological status, dark blue (equivalent to 1) indicate little to no impact from the CAs and correspondingly higher ecological status. In the second map, the score for each 4km cell is an average of the overall ecological status scores of the 30m pixels within the 4km cell.

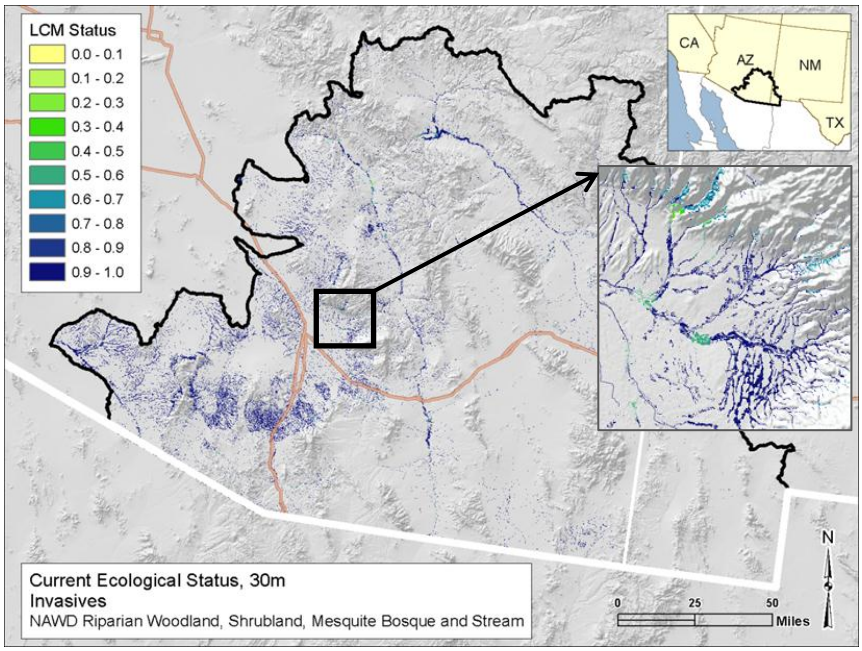
The graph below indicates the frequency distribution of ecological status scores for the CE. The x-axis represents the 0.1 increment scoring intervals, while the y-axis shows the number of grid cells in each interval (left) and the cumulative percentage of the grid cells for each interval (red curve line). This example indicates that 70% of the reporting units are under 0.6 (low to moderate) level of ecological status.

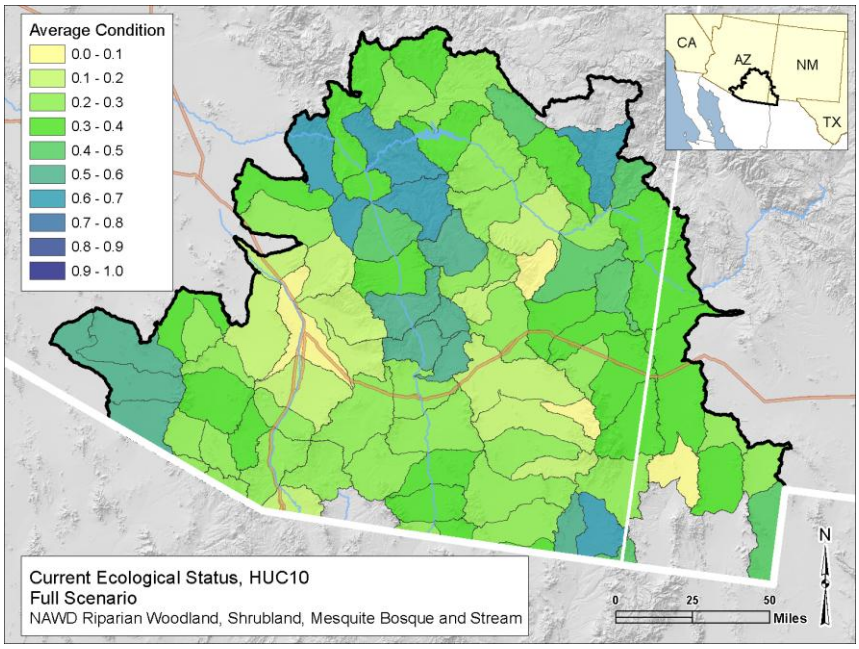


Products and Key Findings

Aquatic conservation element ecological status assessment

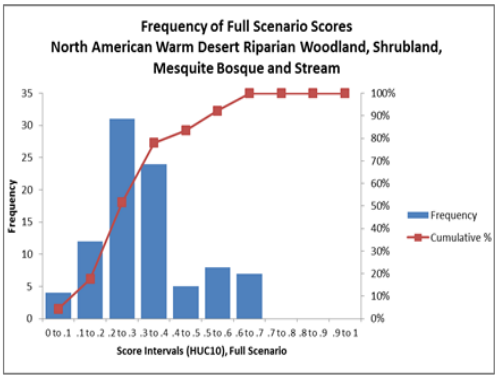
The status assessment for these CEs was similar to terrestrial CE assessment but included the following key ecological attributes (KEA) indicators: Native Riparian/ Aquatic Faunal Composition measured the presence and abundance of native fish, endangered species and freshwater macro-invertebrate index; Non-Native Riparian/ Aquatic Flora and Fauna Composition measured the presence and abundance of non-native invasive species; Hydrologic Regime measured the relative amount of total surface and ground water use; and Geomorphology measured the condition of the stream channel, banks, and floodplain, and amount of vegetation cover to withstand erosional forces.





Indicator scores for Aquatic and Terrestrial Invasive Species indicator for the North American Warm Desert Riparian Woodland, Shrubland, Mesquite Bosque and Stream CE. Top figure is the indicator status based on invasive species presence, bottom figure is the summary status rolled up to watersheds. Inset in top map is of the Tuscon, AZ area. Bottom chart of status by reporting unit watersheds indicating most units are of very low status.

Cottonwood and in-channel marshes along the Lower San Pedro River. *Photo by aziba.org*

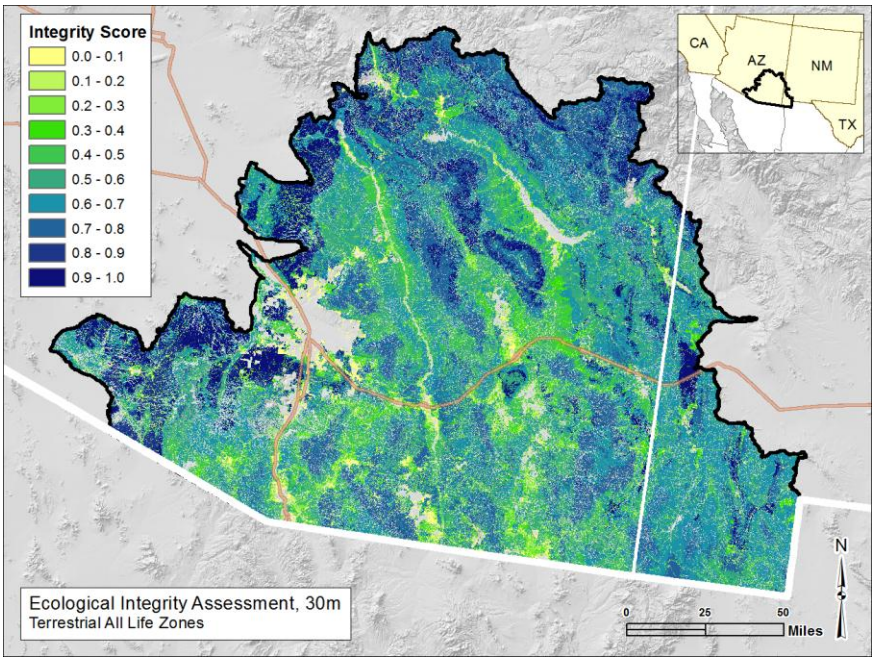


Ecoregion Ecological Integrity

Ecological integrity characterizes the overall integrity or condition of the ecoregion. Because the distribution of the selected CEs of the MAR REA do not cover the entire ecoregion, integrity was instead assessed for five life zones: two for the aquatic realm (montane and lowland) and three for the uplands (montane, valley and desert). An additional analysis looked at the change in extent of distribution for upland ecological systems, a comparison of historical distribution with current.

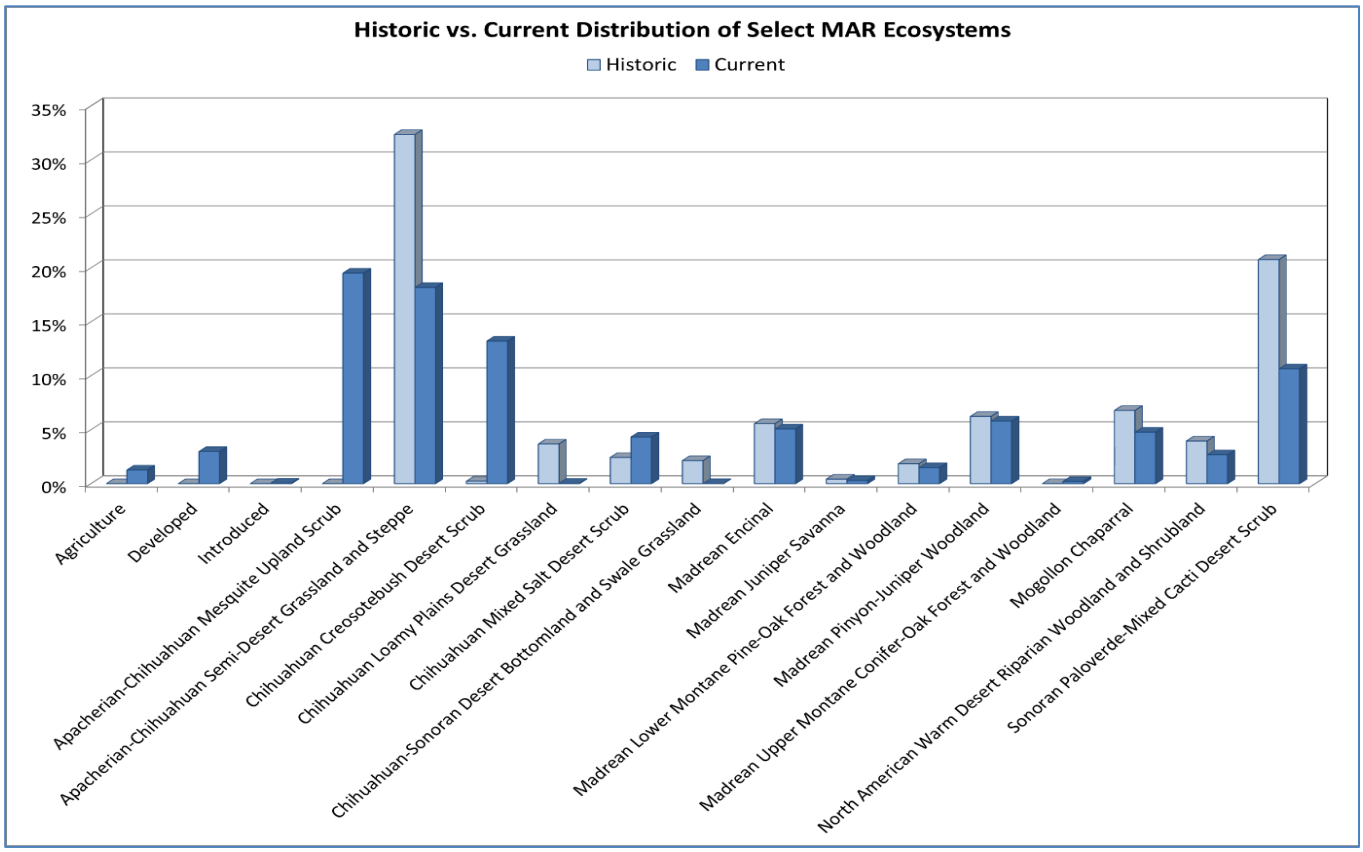
Current ecological integrity scores for all three Terrestrial Life Zones

This map combines results for the three terrestrial life zones. Yellow scores (equivalent to 0) indicate high impacts from the change agents, dark blue (equivalent to 1) indicate little to no impacts. Gray areas are places with development, agricultural activities, or introduced exotic vegetation types that have completely displaced the native ecosystems



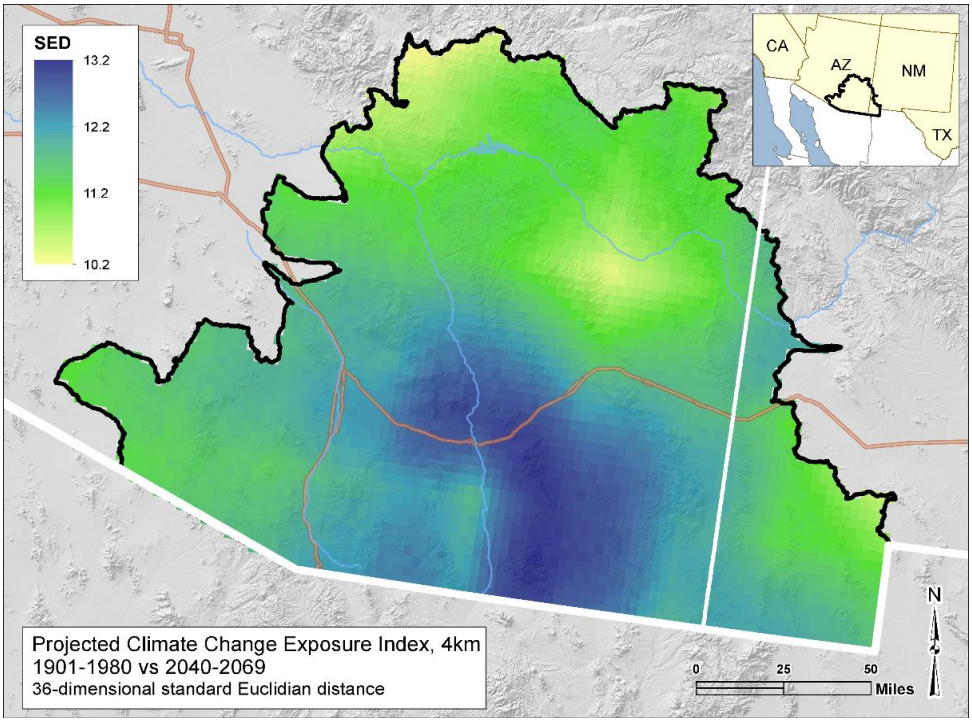
Ecosystem change in extent chart

The y-axis presents the percent of the MAR study area of the mapped historical or current extent of each ecological system or land cover type.



Climate Change

The climate change assessments compared differences in temperature and precipitation between two time periods (recent—1981-2012 vs baseline—1901-1980 and future—2040-2069 vs. baseline). These differences are expressed in actual units of climate (degrees Celsius or mm of precipitation) as well as in relation to historical variability (units of standard deviation from the baseline mean). For recent trends only, additional analysis explores statistically significant trends within the recent period (as opposed to comparing it to a baseline climate). Assessment of CE climate stress (not shown) and bioclimate envelopes (bottom figure) were also conducted.

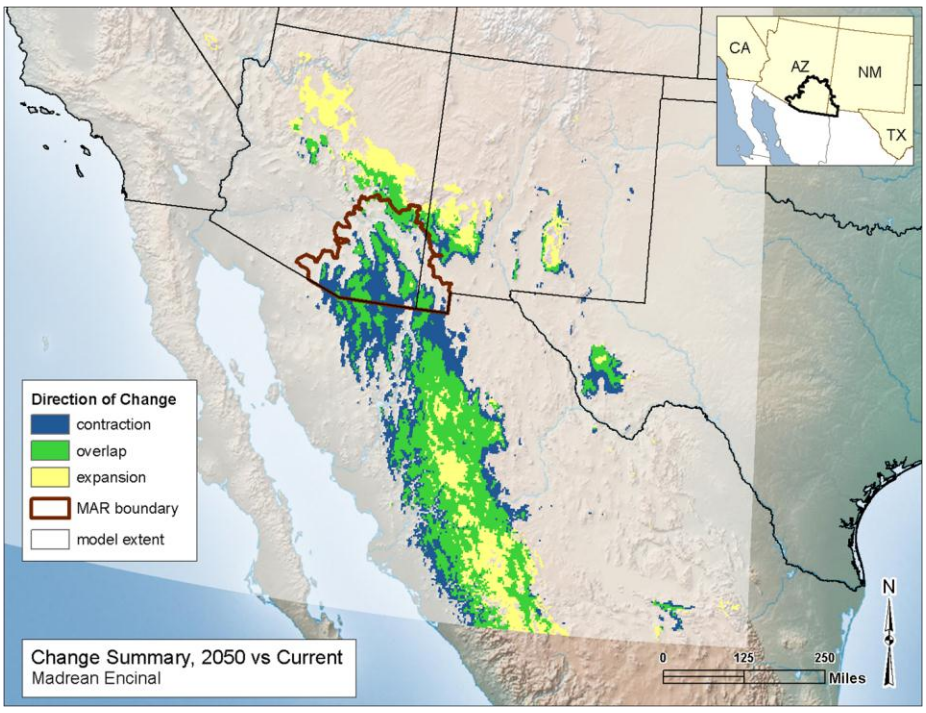


Climate Change Exposure Index, observed values.

In this map, only the upper values of the projected climate change exposure index are displayed. All values shown represent significant change in climate; displaying only the values of the scale range that are present allows visualization of the different values for projected climate exposure across the ecoregion.

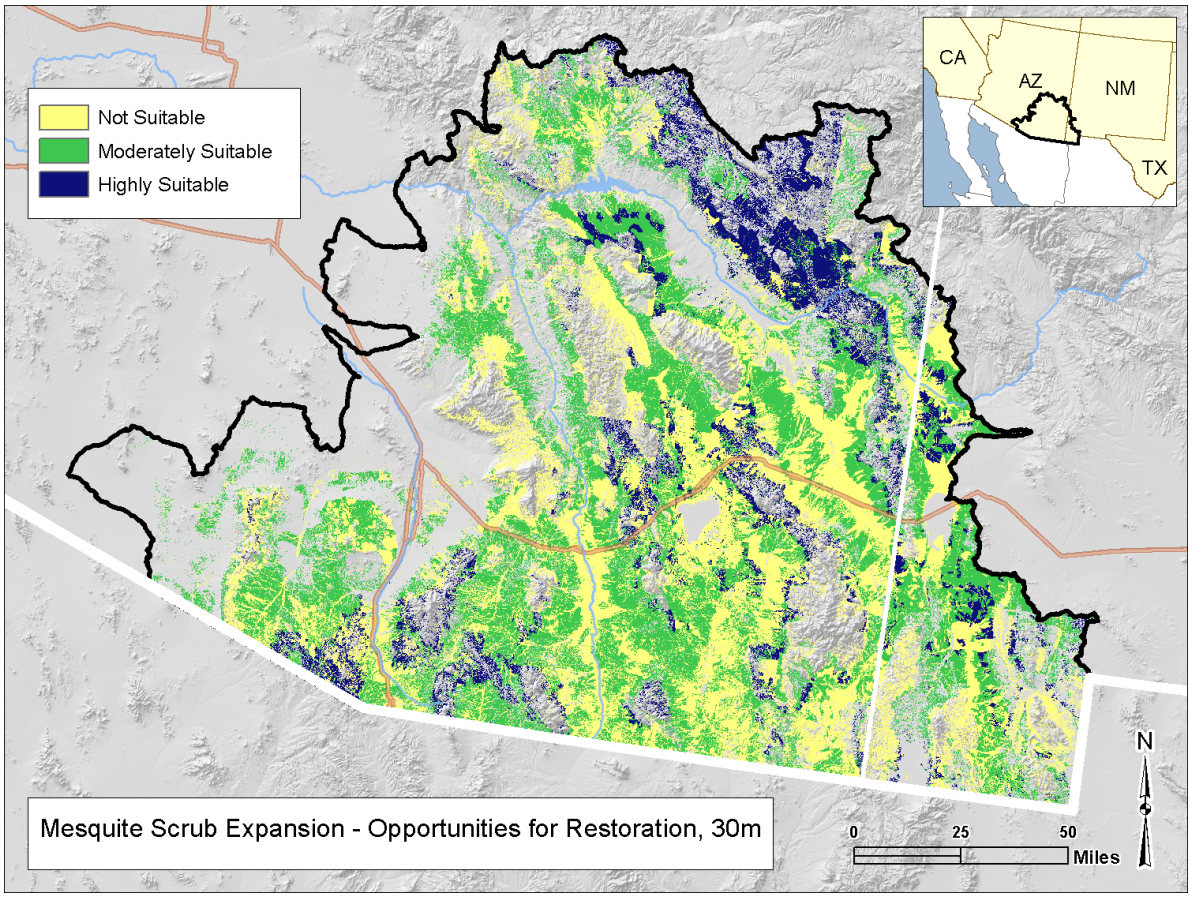
Summary of modeled expansion, contraction, and stability for the geographic distribution of suitable climate conditions for Madrean Encinal.

Contraction areas are where suitable climate for the conservation element currently exists but may not in the future, overlap is where current and future climate are suitable, and expansion is where current climate is not suitable but may be in the future. This assessment did not take into account other factors important to the CEs.



Special assessments

These assessments included risk from future development by 2025 for three case study CEs, identification of moderate to high suitability for restoration of mesquite invaded areas, and areas susceptible to water erosion. The map below indicates the degree of suitability for restoring areas already invaded by mesquite scrub.



Appropriate Use and Access to Products

The key products generated by the MAR REA include:

- Geospatial (GIS) data sets including all inputs and outputs
- A multi-volume final report, work plan, and phase I report
- A decision support system to replicate or update the results and apply the results to management decisions

In general, the results of the analyses are intended to be applied to landscape/watershed-scale questions where the status of conservation elements and general patterns are informative. Questions that seek to establish firm boundaries on the ground or apply management actions will often require the use of supplemental, local data and on-site assessment and confirmation prior to completing decisions. Further, like all REAs, this REA did not systematically treat all biodiversity. In particular, many rare, imperiled, or legally protected species are considered "local species" that are not typically treated in REAs so the MAR REA results should not be used to screen projects for potential conflicts with such species.

BLM provides online tools to access the final report and data products. Most map graphics in the final report are hyperlinked to the interactive map viewer that allows many functions to explore the data including panning, zooming, and examining attributes and metadata.